

WHAT IS CLAIMED IS:

1                   1.     A method of estimating engine torque loss due to a fan  
2     comprising the steps of:  
3                    compiling a table of maximum fan torque losses at a plurality of  
4     engine speeds;  
5                    configuring an engine control unit (ECU) with the table of maximum  
6     fan torque losses;  
7                    retrieving from the table a first maximum fan torque loss and a  
8     second maximum fan torque loss for an engine speed;  
9                    interpolating between the first maximum fan torque loss and the  
10    second maximum fan torque loss to estimate a maximum fan torque loss for the  
11    engine speed; and  
12                   calculating an engine torque loss estimate by adjusting the maximum  
13    fan torque loss based on a set of predetermined fan characteristics.

1                   2.     The method according to claim 1 wherein adjusting the  
2     maximum fan torque loss based on the set of predetermined fan characteristics  
3     comprises the steps of:  
4                    determining if the fan is a single speed fan;  
5                    determining if the fan is operating;  
6                    setting the engine torque loss estimate at zero if the fan is not  
7     operating; and  
8                    setting the engine torque loss estimate at the maximum fan torque loss  
9     if the fan is operating and the fan is a single speed fan.

1                   3.     The method according to claim 2 wherein adjusting the  
2     maximum fan torque loss based on the set of predetermined fan characteristics  
3     further comprises the steps of:  
4                    determining if the fan is a two speed fan;  
5                    determining the operating speed of the fan;  
6                    setting the engine torque loss estimate at zero if the fan is not  
7     operating;

8                    setting the engine torque loss estimate by multiplying the maximum  
9 fan torque loss by a speed scale factor if the fan is a two speed fan operating at low  
10 speed; and  
11                    setting the engine torque loss estimate at the maximum fan torque loss  
12 if the fan is a two speed fan operating at high speed.

1                    4.     The method according to claim 3 wherein adjusting the  
2 maximum fan torque loss based on the set of predetermined fan characteristics  
3 further comprises the steps of:  
4                    determining if the fan is a dual type fan;  
5                    determining how many fans are operating;  
6                    setting the engine torque loss estimate at zero if both fans are not  
7 operating;  
8                    setting the engine torque loss estimate by multiplying the maximum  
9 fan torque loss by an adjustable scale factor if the fan is a dual fan and only one fan  
10 is operating; and  
11                    setting the engine torque loss estimate at the maximum fan torque loss  
12 if the fan is a dual fan with both fans operating.

1                    5.     The method according to claim 4 wherein each of the dual  
2 fans are the same and the adjustable scale factor is 0.5.

1                    6.     The method according to claim 4 wherein adjusting the  
2 maximum fan torque loss based on the set of predetermined fan characteristics  
3 further comprises the steps of:  
4                    determining if the fan is a variable speed fan;  
5                    setting the engine torque loss estimate at zero if the fan is not  
6 operating;  
7                    determining if the fan is operating at or above a maximum duty  
8 cycle;  
9                    multiplying the maximum fan torque loss by a ratio of an actual fan  
10 duty cycle compared to the maximum fan duty cycle if the fan type is a variable fan  
11 and the fan is operating at less than the maximum duty cycle; and

12                    setting the engine torque loss estimate at the maximum fan torque loss  
13   if the fan is a variable speed fan operating at or above the maximum duty cycle.

1                    7.        The method according to claim 6 wherein the maximum duty  
2   cycle is 50% duty cycle.

1                    8.        The method according to claim 1 wherein the engine torque  
2   loss estimate is reported on a digital communication link in a vehicle, the engine  
3   control unit optimally adjusting the operation of the fan according to operating  
4   conditions of the engine and the engine torque loss estimate.

1                    9.        A system for estimating engine torque loss due to a fan  
2   comprising:  
3                    an engine control unit (ECU);  
4                    a digital communication link connected to the engine control unit; and  
5                    a fan connected to the digital communication link;  
6                    wherein the ECU calculates a maximum fan torque loss by  
7   interpolating between a plurality of maximum fan torque loss values based on engine  
8   speed stored in a table in the ECU; the maximum fan torque loss being adjusted to  
9   obtain a fan torque loss estimate based on a set of predetermined fan characteristics.

1                    10.      The system according to claim 9 wherein the set of  
2   predetermined fan characteristics comprise whether the fan is a single speed fan, a  
3   two speed fan, a variable speed fan, and a dual fan..

1                    11.      The system according to claim 9 wherein the set of  
2   predetermined fan characteristics comprise the type of fan used and the operating  
3   speed of the fan.

1                    12.      The system according to claim 9 wherein the digital  
communication link comprises a SAE J1939 digital communication link.